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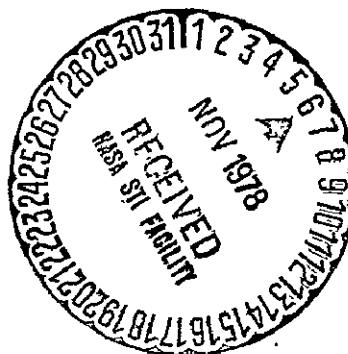
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FY 1977 SCIENTIFIC AND TECHNICAL REPORTS,
ARTICLES, PAPERS, AND PRESENTATIONS

Compiled by O. L. White
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*George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama*

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FOREWORD

In accordance with the NASA Space Act of 1958 the MSFC has provided for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

Since July 1, 1960, when the George C. Marshall Space Flight Center was organized, the reporting of scientific and engineering information has been considered a prime responsibility of the Center. Our credo has been that "research and development work is valuable, but only if its results can be communicated and made understandable to others."

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GEORGE C. MARSHALL SPACE FLIGHT CENTER
Marshall Space Flight Center, Alabama

FY 1977 SCIENTIFIC AND TECHNICAL REPORTS,
ARTICLES, PAPERS, AND PRESENTATIONS

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TM X-3449 November 1976
Information on the Metric System and
Related Fields. Ernst Lange.
N77-12992

This document contains about 7600 references on the metric system and conversion to the metric system. These references include all known documents on the metric system as of December 1975, the month of enactment of the Metric Conversion Act of 1975. This bibliography includes books, reports, articles, presentations, periodicals, legislation, motion pictures, TV series, film strips, slides, posters, wall charts, education and training courses, addresses for information, and sources for metric materials and services. The bibliography is comprehensively indexed for quick retrieval.

TM X-3450 October 1976
Meteorological Regimes for the Classification of Aerospace Air Quality Predictions for NASA-Kennedy Space Center. J. Briscoe Stephens and Joseph C. Sloan. Space Sciences Laboratory.
N77-11570

This report defines a procedure for developing a statistical air quality assessment for the launch of an aerospace vehicle from the Kennedy Space Center in terms of existing climatological data sets. The procedure can be refined as developing meteorological conditions are identified for use with the NASA-Marshall Space Flight Center Rocket Exhaust Effluent Diffusion (REED) description. Fundamentally, this procedure involves the use of classical climatological regimes for the long-range analysis that can be narrowed as the synoptic and mesoscale structure is identified. Only broad synoptic regimes are identified at this stage of analysis. However, as the statistical data

matrix is developed, these synoptic regimes will be refined in terms of the resulting eigenvectors as applicable to aerospace air quality predictions.

TM X-3458 December 1976
Space Processing Applications Rocket Project SPAR I Final Report. Space Processing Applications Rocket Project Office, Special Projects. N77-16082

This document summarizes the experiment objectives, design/operational concepts, and final results of each of nine scientific experiments conducted during the first Space Processing Applications Rocket (SPAR) flight flown by NASA in December 1975. The nine individual SPAR experiments, covering a wide and varied range of scientific materials processing objectives, were entitled: Solidification of Pb-Sb Eutectic, Feasibility of Producing Closed-Cell Metal Foams, Characterization of Rocket Vibration Environment by Measurement of Mixing of Two Liquids, Uniform Dispersions of Crystallization Processing, Direct Observation of Solidification as a Function of Gravity Levels, Casting Thoria Dispersion-Strengthened Interfaces, Contained Polycrystalline Solidification, and Preparation of a Special Alloy for Manufacturing of Magnetic Hard Superconductor Under Zero-g Environment.

TM X-3490 February 1977
A Survey of Compiler Development Aids. B. P. Buckles, B. C. Hodges, and P. Hsia. Data Systems Laboratory.
N77-17756

This report establishes a theoretical background for the compilation process by dividing it into five phases and explaining the concepts and algorithms that underpin each. The five selected phases are lexical

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analysis, syntax analysis, semantic analysis, optimization, and code generation. Several methods for both top-down and bottom-up syntax analysis are illustrated via examples. Graph theoretical optimization techniques are likewise presented, and approaches to code generation are described for both one-pass and multipass compilation environments. Following the initial tutorial sections, more than 20 tools that have been developed to aid in the process of writing compilers are surveyed. Care is taken to categorize each according to the theoretical framework just established. A uniform notation is used throughout this portion rather than resorting to that notation used by each individual system. Eight of the more recent compiler development aids are selected for special attention — SIMCMP/STAGE2, LANG-PAK, COGENT, XPL, AED, CWIC, LIS, and JOCIT. The concluding sections assess the impact of compiler development aids, describe some of their shortcomings, and inspect some of the areas of research currently in progress.

TM X-3509 March 1977
Solar Absorption Characteristics of
Several Coatings and Surface Finishes.
James R. Lowery. N77-20567

The results of a study conducted to determine the solar absorption characteristics of several films potentially favorable for use as receiving surfaces in solar energy collectors are presented. Included in the investigation were chemically produced black films, black electrodeposits, and anodized coatings.

The results of this study showed that black nickel exhibited the best combination of selective optical properties of any of the coatings studied. A serious drawback to black nickel was its high susceptibility to degradation in the presence of high moisture

environments. Electroplated black chrome generally exhibited high solar absorptivities, but the emissivity varied considerably and was also relatively high under some conditions. The black chrome had the greatest moisture resistance of any of the coatings tested. Black oxide coatings on copper and steel substrates showed the best combination of selective optical properties of any of the chemical conversion films studied.

TM X-73342 July 1976
Computer Simulation Results of Attitude Estimation of Earth Orbiting Satellites. Shanying R. Kou. Systems Dynamics Laboratory. N76-32213

Computer simulation results of attitude estimation of Earth-orbiting satellites (including Space Telescope) subjected to environmental disturbances and noises are presented in this report. Decomposed linear recursive filter and Kalman filter were used as estimation tools. Six programs were developed for this simulation, and all were written in BASIC language and were executed in computers HP 9830A and HP 9866A. Simulation results show that a decomposed linear recursive filter is accurate in estimation and fast in response time. Furthermore, for higher order systems, this filter has computational advantages (i.e., less integration errors and roundoff errors) over Kalman filter.

TM X-73343 September 1976
Space Telescope Coordinate Systems,
Symbols, and Nomenclature Definitions.
Hans F. Kennel. Systems Dynamics Laboratory.
N76-33101

The major coordinate systems as well as the transformations and transformation angles between them for the Space Telescope are defined in this report. The

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coordinate systems were primarily developed for use in pointing and control system analysis and simulation. Additional useful information (on nomenclature, symbols, quaternion operations, etc.) is contained in the appendices.

TM X-73344 November 15, 1976
Satellite Power Systems An Engineering
and Economic Analysis Summary. Pro-
gram Development. N77-15486

A system engineering and economic analysis was conducted to establish typical reference baselines for the photovoltaic, solar thermal, and nuclear Satellite Power Systems. Tentative conclusions indicate that feasibility and economic viability are characteristic of the Satellite Power System and, therefore, deserve additional study. Many key issues exist but appear resolvable with the anticipated technological advances of the next decades.

TM X-73345 September 1976
A Status of Progress for the Laser
Isotope Separation (LIS) Process. Dr.
Leon M. Delionback. Systems Analysis
and Integration Laboratory.
N76-33496

Since the earlier days of the patent by the Israeli scientists (Nebenzahl and Leven, 1973), a virtual explosion of information on Laser Isotope Separation (LIS) has occurred. Research is apparently going on in several European countries and particularly in Russia. References vary from German patents to the Soviet Journal of Quantum Electronics, the American Science Journal, and then finally to the Science Fiction magazine, Analog.

An overview of the various categories of the LIS methodology is given together

with illustrations showing a simplified version of the LIS technique, an example of the two-photon photoionization category, and a diagram depicting how the energy levels of various isotope influence the LIS process.

Applications have been proposed for the LIS system which, in addition to the use to enrich uranium, could in themselves develop into programs of tremendous scope and breadth. Such applications as treatment of radioactive wastes from light-water nuclear reactors, enriching the deuterium isotope to make heavy-water, and enriching the light isotopes of such elements as titanium for aerospace weight-reducing programs.

Economic comparisons of the LIS methodology with the current method of gaseous diffusion indicate an overwhelming advantage; the laser promises to be 1000 times more efficient. The technique could also be utilized in chemical reactions with the tuned laser serving as a universal catalyst to determine the speed and direction of a chemical reaction.

TM X-73346 September 1976
Compilation of Flares and Transients
Observed by the S-056 Solar X-Ray
Telescope During the Skylab Missions.
D. M. Speich, J. B. Smith, Jr., E. J.
Reichmann, J. P. McGuire, J. A.
Vorpahl, and D. L. McKenzie. Space
Sciences Laboratory. N77-10990

During the manned operation of the Skylab Apollo Telescope Mount, the Marshall Space Flight Center/The Aerospace Corporation solar X-ray telescope (S-056) observed many solar flares and transient solar phenomena. This report correlates those X-ray observations with events reported by H-alpha observers and those

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recorded by integrating X-ray satellite detectors. Data included for individual events are:

1. Type of H-alpha activity
2. H-alpha begin, maximum, and end times
3. SOLRAD 9 or VELA X-ray (1 to 8 Å) peak flux and time of peak flux
4. Begin time of S-056 observations
5. Approximate heliographic location
6. Boulder and McMath active region numbers.

Minor X-ray transients and structural changes are not included in this report.

TM X-73347 September 1976
Evaluation Criteria for Software Classification Inventories, Accuracies, and Maps. Robert R. Jayroe, Jr. Data Systems Laboratory. N77-10608

The main tool for comparing remote sensing classification results with ground truth information is a contingency table derived from overlaying digital classification and ground truth maps. The purpose of this report is to explore methods of deriving a maximum amount of information from the contingency table and of modifying the contingency table to provide more information. This report contains 15 different statistical criteria derived from a contingency table that can be used to evaluate tabular classification results, which unfortunately provide little information on the visual characteristics of a classification map. Tabular results provide information relating mainly to how much rather than where, which is the purpose of a map. Therefore

modifications are proposed to the contingency table which contain information on the spatial complexity of the test site, on the relative location of classification errors, on how well the classification maps agree with the ground truth maps, and which reduce back to the original information normally contained in a contingency table.

TM X-73348 September 1976
Nearest Neighbor, Bilinear Interpolation and Bicubic Interpolation Geographic Correction Effects on Landsat Imagery. Robert R. Jayroe, Jr. Data Systems Laboratory. N77-10609

The objectives of this work are to identify effects that are observed in Landsat image data when the image data are geographically corrected using the nearest neighbor, bilinear interpolation and bicubic interpolation registration techniques, and to identify potential impacts of registration on image compression and classification.

TM X-73349 April 1976
Spacelab Experiment Computer Study Vol. I: Executive Summary (Presentation). James L. Lewis, Bobby C. Hodges, and James O. Christy. N77-13097

The purpose of this study was to provide a quantitative cost for various Spacelab flight hardware configurations, along with varied software development options. The three major conclusions reached as a result of this study are as follows:

1. Spacelab program cost for software development and maintenance is independent of experimental hardware and software options.

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2. Distributed standard computer concept simplifies software integration without a significant increase in cost.

3. Decision on flight computer hardware configuration should not be made until payload selection for a given mission and a detailed analysis of the mission requirements are completed.

This report is published in five volumes: Volume I contains the Executive Summary (Presentation); Volume II, Study Elements and Approach; Volume III, Spacelab Cost Data; Volume IV, Spacelab User Cost Data (Central Experiment Computer); and Volume V, Spacelab User Cost Data (Distributed Computer).

This is Volume I: Executive Summary (Presentation).

TM X-73349 April 1976
Spacelab Experiment Computer Study
Volume II: Study Elements and
Approach. James L. Lewis, Bobby C.
Hodges, and James O. Christy.
N77-13098

The purpose of this study was to provide a quantitative cost for various Spacelab flight hardware configurations, along with varied software development options. The three major conclusions reached as a result of this study are as follows:

1. Spacelab program cost for software development and maintenance is independent of experimental hardware and software options.

2. Distributed standard computer concept simplifies software integration without a significant increase in cost.

3. Decision on flight computer hardware configuration should not be made until payload selection for a given mission and a detailed analysis of the mission requirements are completed.

This report is published in five volumes: Volume I contains the Executive Summary (Presentation); Volume II, Study Elements and Approach; Volume III, Spacelab Cost Data; Volume IV, Spacelab User Cost Data (Central Experiment Computer); and Volume V, Spacelab User Cost Data (Distributed Computer).

This is Volume II: Study Elements and Approach.

TM X-73349 April 1976
Spacelab Experiment Computer Study
Volume III. Spacelab Cost Data. James
L. Lewis, Bobby C. Hodges, and James
O. Christy. N77-13099

The purpose of this study was to provide a quantitative cost for various Spacelab flight hardware configurations, along with varied software development options. The three major conclusions reached as a result of this study are as follows:

1. Spacelab program cost for software development and maintenance is independent of experimental hardware and software options.

2. Distributed standard computer concept simplifies software integration without a significant increase in cost.

3. Decision on flight computer hardware configuration should not be made until payload selection for a given mission and a

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detailed analysis of the mission requirements are completed.

This report is published in five volumes: Volume I contains the Executive Summary (Presentation); Volume II, Study Elements and Approach; Volume III, Spacelab Cost Data; Volume IV, Spacelab User Cost Data (Central Experiment Computer); and Volume V, Spacelab User Cost Data (Distributed Computer).

This is Volume III: Spacelab Cost Data, which provides the detailed costing methods and cost data.

TM X73349 April 1976
Spacelab Experiment Computer Study
Vol. IV: Spacelab User Cost Data
(Central Experiment Computer). James
L. Lewis, Bobby C. Hodges, and James
O. Christy. N77-13100

The purpose of this study was to provide a quantitative cost for various Spacelab flight hardware configurations, along with varied software development options. The three major conclusions reached as a result of this study are as follows:

1. Spacelab program cost for software development and maintenance is independent of experimental hardware and software options.

2. Distributed standard computer concept simplifies software integration without a significant increase in cost.

3. Decision on flight computer hardware configuration should not be made until payload selection for a given mission and a detailed analysis of the mission requirements are completed.

This report is published in five volumes: Volume I contains the Executive Summary (Presentation); Volume II, Study Elements and Approach; Volume III, Spacelab Cost Data; Volume IV, Spacelab User Cost Data (Central Experiment Computer); and Volume V, Spacelab User Cost Data (Distributed Computer).

This is Volume IV: Spacelab User Cost Data (Central Experiment Computer).

TM X-73349 April 1976
Spacelab Experiment Computer Study
Volume V: Spacelab User Cost Data
(Distributed Computer).

The purpose of this study was to provide a quantitative cost for various Spacelab flight hardware configurations, along with varied software development options. The three major conclusions reached as a result of this study are as follows:

1. Spacelab program cost for software development and maintenance is independent of experimental hardware and software options.

2. Distributed standard computer concept simplifies software integration without a significant increase in cost.

3. Decision on flight computer hardware configuration should not be made until payload selection for a given mission and a detailed analysis of the mission requirements are completed.

This report is published in five volumes: Volume I contains the Executive Summary (Presentation); Volume II, Study Elements and Approach; Volume III, Spacelab Cost Data; Volume IV, Spacelab User

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Cost Data (Central Experiment Computer);
and Volume V, Spacelab User Cost Data
(Distributed Computer).

This is Volume V: Spacelab User Cost
Data (Distributed Computer).

TM X-73350 November 1976
Parameters Affecting Electrostatic Cool-
ing. K. E. Demorest and R. L. Gause.
Materials and Processes Laboratory.
N77-12329

A high voltage electrostatic field enhances the rate of normal convective cooling. This cooling rate is a function of starting temperature and voltage applied, and an inverse function of atmospheric pressure or the heat capacity of the surrounding media. It appears that the cooling rate is also a function of current flow; however, additional work is needed to separate other variables from the effect of current flow.

The maximum increase in heat loss over the normal convective cooling was approximately $0.167^{\circ}\text{C}/\text{sec}$ ($0.3^{\circ}\text{F}/\text{sec}$) at 316°C (600°F) and 20 000 V. From the data taken it is assumed that the added rate of cooling would be increased with higher temperatures and higher voltages.

It appears that a high voltage field disrupts the molecular layer of air surrounding a hot body and increases the rate of convective cooling.

Future tests are planned to further characterize this phenomenon and to determine applications for electrostatic cooling.

TM X-73352 November 1976
Application of Redundancy in the
Saturn V Guidance and Control
System. F. Brooks Moore and J. B.

White. Electronics and Control Labora-
tory. N77-13102

The Saturn launch vehicle's guidance and control system is so complex that the reliability of a simplex system is not adequate to fulfill mission requirements. Thus, to achieve the desired reliability, redundancy encompassing a wide range of types and levels was employed. At one extreme, the lowest level, basic components (resistors, capacitors, relays, etc.) are employed in series, parallel, or quadruplex arrangements to insure continued system operation in the presence of possible failure conditions. At the other extreme, the highest level, complete subsystem duplication is provided so that a backup subsystem can be employed in case the primary system malfunctions. In between these two extremes, many other redundancy schemes and techniques are employed at various levels. Basic redundancy concepts are covered to gain insight into the advantages obtained with various techniques. Points and methods of application of these techniques are included. The theoretical gain in reliability resulting from redundancy is assessed and compared to a simplex system. Problems and limitations encountered in the practical application of redundancy are discussed as well as techniques verifying proper operation of the redundant channels. As background for the redundancy application discussion, a basic description of the guidance and control system is included.

TM X-73353 December 1976
Contamination from Skylab as Deter-
mined from the Solar Coronagraph
Data. James P. McGuire. Space Sciences
Laboratory. N77-13138

The white light solar coronagraph was
one of the scientific telescopes flown on

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Skylab to study the Sun. It studied the Sun's atmosphere located from 0.5 to 5.0 solar radii above the Sun's limb. Such a telescope is so sensitive to contamination around the spacecraft that it caused a major contamination abatement program to be initiated at the conception of Skylab. This report analyzes the coronagraph's data, showing the successfulness of that abatement program.

TM X73354 November 1976
Laser Doppler Systems in Atmospheric
Turbulence. S. S. R. Murty. Electronics
and Control Laboratory. N77-14297

This report is concerned with the estimation of the loss of heterodyne signal power for the Marshall Space Flight Center laser Doppler system due to the random changes in the atmospheric index of refraction. The current status in the physics of low-energy laser propagation through turbulent atmosphere is presented, as well as the analysis and approximate evaluation of the loss of the heterodyne signal power due to the atmospheric turbulence. The losses due to the atmospheric absorption, scattering, and turbulence are estimated for the conditions of the January 1973 flight tests, and theoretical and experimental signal to noise values are compared. In addition, the maximum and minimum values of the atmospheric attenuation over a two-way path of 20 km range are calculated as a function of altitude using models of atmosphere, aerosol concentration, and turbulence.

TM X-73355 September 1976
A Performance Evaluation of Various
Coatings, Substrate Materials, and Solar
Collector Systems. F. J. Dolan.
Materials and Processes Laboratory.
N77-15489

The energy crisis and a national concern for conserving energy resources have caused Congress to establish the Energy Research and Development Administration (ERDA). The ERDA has enlisted the Marshall Space Flight Center to perform certain aspects of a research and development program directed toward demonstrating the practical use of solar heating within 3 years and combined solar heating and cooling within 5 years. In conjunction with this solar research and development effort, it became apparent that a method of testing and evaluating solar panel coatings and designs and solar collector subsystems was necessary to quickly and easily make comparisons between representative candidate samples of each. An experimental apparatus was constructed and utilized in conjunction with both a solar simulator and actual sunlight to test and evaluate various solar panel coatings, panel designs, and scaled-down collector subsystems. Data were taken by an automatic digital data acquisition system and reduced and printed by a computer system. The solar collector test setup, data acquisition system, and data reduction and printout systems were considered to have operated very satisfactorily. Test data indicated that there is a practical or useful limit in scaling down beyond which scaled-down testing cannot produce results comparable to results of larger scale tests. Test data are presented herein as are schematics and pictures of test equipment and test hardware.

TM X-73357 December 1976
The 15 June 1973 1B/M3 Flare: An
Overview of Analysis Results. Robert
M. Wilson. Space Sciences Laboratory.
N77-17986

An overview of the data analysis results reported in the literature, to date, of the 15

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June 1973 1B/M3 flare is presented. Some 30 papers have been published relative to this event. This work was performed to assist the participants of the Skylab Solar Workshop Series B on Solar Flares to become familiar with one of the best observed flares during the Skylab mission.

TM X-73358 November 29, 1976
Charged Particle Radiation Environment
for the Spacelab and Other Missions in
Low Earth Orbit - Revision A. John
W. Watts, Jr. and Jerry J. Wright. Space
Sciences Laboratory. N77-16979

The physical charged particle dose to be encountered in low Earth Orbit Spacelab missions is estimated for orbits of inclinations from 28.5 to 90° and altitudes from 200 to 800 km. The dose encountered is strongly altitude dependent, with a weaker dependence on inclination. Doses range from 0.007 rads/day at 28.5° and 200 km to 1.57 rads/day at 28.5° and 800 km behind a 5.0 g/cm² shield. Geomagnetically trapped protons were the primary source of damage over most of the range of altitudes and inclinations, with galactic cosmic rays making a significant contribution at the lowest altitudes.

TM X-73359 January 1977
The Stress Corrosion Resistance and the
Cryogenic Temperature Mechanical
Properties of Annealed Nitronic 60 Bar
Material. J. W. Montano. Materials and
Processes Laboratory. N77-16149

This report presents the ambient and cryogenic temperature mechanical properties and the ambient temperature stress corrosion properties of annealed, straightened, and centerless ground Nitronic 60 stainless steel alloy bar material.

The mechanical properties of longitudinal specimens were evaluated at test temperatures from ambient to liquid hydrogen. The tensile test data indicated increasing strength with decreasing temperature to -320°F (-196.0°C). Below liquid nitrogen temperature the smooth tensile and notched tensile strengths decreased slightly while the elongation and reduction of area decreased drastically. The Charpy V-notched impact energy decreased steadily with decreasing test temperature.

Stress corrosion tests were performed on longitudinal tensile specimens and transverse "C"-ring specimens exposed to: alternate immersion in a 3.5% NaCl bath; humidity cabinet; and a 5% salt spray atmosphere. The longitudinal tensile specimens experienced no corrosive attack. Approximately 3/4 of the transverse "C"-rings exposed to alternate immersion and to salt spray experienced a pitting attack on the top and bottom ends. The "C"-rings exposed to the humidity cabinet indicated only mild rusting.

Additional stress corrosion tests were performed on transverse tensile specimens which were machined from an annealed, straightened, and centerless ground 2.50-inch (6.35 cm) diameter bar. No failures occurred in the 90% stressed specimens exposed for 90 days in the alternate immersion and salt spray environments.

TM X-73360 January 1977
Apollo-Soyuz Test Project - Composite
of MSFC Final Science Report.
Advanced Projects Office. N77-19121

This report summarizes the experimental procedures of nine experiments conducted during the Apollo-Soyuz Test

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Project mission from July 15 to July 24, 1975, and presents the investigators' conclusions and recommendations based on these experiments. The experiments reported on herein are:

- Experiment MA-011, Column Electrophoresis on the Apollo-Soyuz Test Project – Section I

- Experiment MA-014, Electrophoresis Experiment – Section II

- Experiment MA-041, Surface Tension Induced Convection in Encapsulated Liquid Metals in a Microgravity Environment – Section III

- Experiment MA-044, Monotectic and Syntectic Alloys – Section IV

- Experiment MA-060, Quantitative Determination of Zero-Gravity Effects on Electronic Materials Processing – Germanium Crystal Growth with Simultaneous Interface Demarcation – Section V

- Experiment MA-070, Zero-G Processing of Magnets – Section VI

- Experiment MA-085, Crystal Growth from the Vapor Phase – Section VII

- Experiment MA-131, Zero-Gravity Growth of NaCl-LiF Eutectic – Section VIII

- Experiment MA-150, Germanium – Silicon Solid Solutions – Section IX.

TM X-73361 January 1977
Numerical Solutions of Navier-Stokes Equations for the Structure of a Trailing Vortex. A. C. Jain. Systems Dynamics Laboratory. N77-16993

An attempt is made to understand the structure and decay of a trailing vortex through the numerical solutions of the full Navier-Stokes equations. Unsteady forms of the governing equations are recast in terms of circulation, vorticity, and stream function as dependent variables, and a second upwind finite difference scheme is used to integrate them with prescribed initial and boundary conditions. A discussion of the boundary conditions at the outer edge and at the outflow section of the trailing vortex is included. Different models of the flow are postulated, and solutions are obtained describing the development of the flow as integration proceeds in time. A parametric study is undertaken with a view to understand the various phenomena that may possibly occur in the trailing vortex. Using the Hoffman and Joubert law of circulation at the inflow section, the results of the present investigation are compared with the experimental data of Chigier and Corsiglia on a Convair 990 wing model and a rectangular wing. With an exponentially decaying law of circulation at the inflow section and an adverse pressure gradient at the outer edge of the trailing vortex, solutions depict vortex bursting through the sudden expansion of the core and/or through the stagnation and consequent reversal of the flow on the axis. It is found that this bursting takes place at lower values of the swirl ratio as the Reynolds number increases.

TM X-73362 January 1977
A Long-Lived Coronal X-Ray Arcade. J. P. McGuire, E. Tandberg-Hanssen, K. R. Krall, S. T. Wu, J. B. Smith, Jr., and D. M. Speich. Space Sciences Laboratory. N77-17993

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A large, long-lived, soft X-ray emitting arch system was observed during the last Skylab mission. This arcade of arches stayed in the same approximate position for several solar rotations. This report suggests that these long-lived arches owe their stability to the stable coronal magnetic-field configuration. A global constant α force-free magnetic field analysis, as developed by Nakagawa et al., is used to describe the arches, and a marked resemblance is noted between the theoretical magnetic-field configuration and the observed X-ray emitting feature.

TM X-73363 January 1977
Skylab ATM/S-056 X-Ray Event
Analyzer Observations Versus Solar
Flare Activity: An Event Compilation.
Robert M. Wilson. Space Sciences
Laboratory. N77-17988

An event compilation is presented which correlates ATM/S-056 X-ray event analyzer solar observations with solar flare activity. Approximately 1070 h of pulse-height analyzed X-ray proportional counter data were obtained with the X-ray event analyzer during Skylab. During its operation, 449 flares (including 343 flare peaks) were observed. Seventy events of peak X-ray emission $\geq C1$ were simultaneously observed by ground-based telescopes, SOLRAD 9 and/or Vela, and the X-ray event analyzer. These events were observed from preflare through flare rise to peak and through flare decline. This work was performed, in part, as a contribution to the Skylab Solar Workshop Series B on Solar Flares.

TM X-73364 December 1976
MSFC Solar Simulator Test Plane
Uniformity Measurement. Donald B.
Griner. Electronics and Control Laboratory.
N77-18558

The equipment and procedure used to measure the test plane uniformity produced by the MSFC 405 lamp solar simulator array are presented along with details on the computer program used to analyze the measurement data. The results of the first measurement are given which showed the uniformity not to be as good as expected. The best uniformity obtained had a standard deviation of 4 percent with peak-to-peak values of ± 11 percent.

TM X-73365 December 1976
Shuttle/Tethered Satellite System Conceptual Design Study. Preliminary
Design Office. N77-18199

Tethers have been proposed for many space applications such as retrieving stranded astronauts, stationkeeping two orbiting vehicles, and suspending scientific payloads into the upper reaches of the atmosphere from a main orbiting vehicle. Subsequent to these proposals, a new ingredient has been added. Namely, a closed-loop control system has been added to the tether reel which improves control over the tethered satellite. In addition to increasing the stability of the tethered satellite along local vertical, this control system can be used for deployment and retrieval of tethered satellites. This conceptual design study describes a tether system for suspending a science payload at an altitude of 120 km from a Space Shuttle Orbiter flying at an altitude of 200 km. In addition to the hardware conceptual designs, various aspects concerning Orbiter accommodations are discussed.

TM X-73366 December 1976
Technical Assessment of High Energy
Astronomy Observatory-B (HEAO-B)
Attitude Control and Determination
Subsystem (ACDS). S&E HEAO-B
ACDS Review Team. N77-19141

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In July 1976, a Team of MSFC Science and Engineering personnel was formed to assess the technical adequacy of the High Energy Astronomy Observatory-B (HEAO-B) Attitude Control and Determination Subsystem (ACDS). As a result of their analysis of the ACDS, the Team found no reason why the ACDS will not perform its specified activities adequately. The Team's activities culminated in their participation in the HEAO-B Critical Design Review.

TM X-73367 February 1977
The Analysis of the X-Ray Event Analyzer Proportional Counter Data: A Comment. Robert M. Wilson. Space Sciences Laboratory. N77-19976

During the Skylab mission (May 1973 through February 1974), the X-ray event analyzer (X-REA), a part of the ATM/S-056 X-ray telescope experiment, monitored the 2.5 to 7.25 Å and 6.1 to 20 Å solar X-ray fluxes. As the mission progressed, it became apparent that the proportional counters of the X-REA were decreasing in sensitivity. This report presents findings, based on a comparison of simultaneous observation of a number of flares obtained with the X-REA and SOLRAD 9 instruments, which reveal the degree of deterioration of the counters with time. These corrections can then be applied to observed data, thus allowing a more accurate determination of the flux levels during the late mission phases and, thereby, extending the usefulness of the X-REA as a plasma diagnostic tool.

TM X-73368 January 1977
On the Dissolution Properties of GaAs in Ga. M. C. Davidson and A. H. Moynahan. Space Sciences Laboratory. N77-19900

The dissolution of GaAs in Ga was studied to determine the nature and cause of faceting effects. Ga was allowed to dissolve single crystalline faces under isothermal conditions. Of the crystalline planes with low number indices, only the (100) surface showed a direct correlation of dissolution sites to dislocations. The type of dissolution experienced depended on temperature, and there were three distinct types of behavior.

TM X-73369 December 1976
Users' Guide to the Data Obtained by the Skylab/ATM NASA-Marshall Space Flight Center/The Aerospace Corporation S-056 X-Ray Experiment. Space Sciences Laboratory. N77-19977

The ATM/S-056 X-Ray Experiment operated successfully on Skylab from May 1973 to February 1974. The S-056 observations consist of 27 000 photographs (filter-heliograms) obtained by the X-ray telescope and 1100 h of proportional counter data obtained by the X-ray event analyzer in the soft X-ray region of the solar spectrum. This report contains a description of the S-056 data together with additional relevant information that may be needed by users of the data. Although the report is intended primarily to describe the data that were sent to the National Space Science Data Center, it should also be useful to other users.

TM X-73370 February 1977
Data for NASA's AVE V Experiment: 25-mb Sounding Data and Synoptic Charts. Mark E. Humbert and Kelly Hill. Space Sciences Laboratory. N77-20698

This report describes the AVE V Experiment and presents tabulated rawinsonde data at 25-mb intervals from the surface to 25 mb for the 23 stations

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participating in the experiment. Soundings were taken between 0000 GMT, June 11, and 1200 GMT, June 12, 1976. The methods of data processing and accuracy are briefly discussed. An example of contact data is also included.

TM X-73371 December 1976
The Role of Fracture Mechanics in the Design of Fuel Tanks in Space Vehicles. Stephen J. Denton and C. K. Liu. Preliminary Design Office. N77-22168

With special reference to design of fuel tanks in space vehicles, the principles of fracture mechanics are reviewed. An approximate but extremely simple relationship among (1) the operating stress level, (2) the length of crack, and (3) the number of cycles of failure is derived, from which any one of the variables can be computed approximately from the knowledge of the other two, if the loading schedule (mission of the tank) is not greatly altered.

Two sample examples illustrating the procedures of determining the allowable safe operating stress corresponding to a set of assumed loading schedule is included in this report. The selection of sample examples is limited by the relatively meager available data on the candidate material for various stress ratios in the cycling.

TM X-73372 December 1976
Operations Research Investigations of Satellite Power Stations. John W. Cole and John L. Ballard. N77-21547

A systems model reflecting the current "in-house" design concepts of Satellite Power Stations (SPS) was developed. The model is of sufficient scope to include the interrelationships of the following major design parameters: the transportation to and

between orbits; assembly of the SPS; and maintenance of the SPS.

The systems model is composed of a set of equations that are nonlinear with respect to the system parameters and decision variables. The model determines a "figure of merit" from which alternative concepts concerning transportation, assembly, and maintenance of satellite power stations can be studied. A hybrid optimization model was developed to optimize the system's decision variables. The optimization model consists of a random search procedure and the optimal-steepest descent method. A FORTRAN computer program was developed to enable the user to optimize nonlinear functions using the model. Specifically, the computer program was used to optimize Satellite Power Station system components.

TM X-73373 February 1977
Manufacturing Complexity Analysis. Dr. Leon M. Delionback. Systems Analysis and Integration Laboratory. N77-20440

This report explains the principle of complexity analysis and its special relationship with learning/cost improvement curve theory.

A "bottoms up" approach for the analysis of the complexity of a typical system is presented. Starting with the subsystems of an example system, the step-by-step procedure for analysis of the complexity of an overall system is given. The learning curves for the various subsystems are determined as well as the concurrent numbers of relevant design parameters. Then trend curves are plotted for the learning curve slopes versus the various design-oriented parameters, e.g.

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number of parts versus slope of learning curve, or number of fasteners versus slope of learning curve, etc.

Representative cuts are taken from each trend curve, and a figure-of-merit analysis is made for each of the subsystems. Based on these values, a characteristic curve is plotted which is indicative of the complexity of the particular subsystem (Figure-of-merit versus learning curve slope). Each such characteristic curve is based on a universe of trend curve data taken from data points observed for the subsystem in question. Thus, a characteristic curve is developed for each of the subsystems in the overall system.

A composite complexity analysis is performed to determine the manufacturing complexity for the overall system. A procedure is outlined to define the steps in computation for this value (along with an illustrative example).

In the discussion a narrative description is given for the limitations in scope of the manufacturing complexity analysis with examples of some of the cost elements that are not included.

TM X-73374 November 1976
Miniaturized Pointing Mount Performance Analysis. Joe T. Howell, Jr.
Preliminary Design Office. N77-20403

Analytical analysis and computer simulation results of the Miniaturized Pointing Mount as an instrument pointing system are presented. Miniaturized Pointing Mount performance results include inertial pointing, slewing, tracking, and rastering. Typical instrument characteristics are used as well as some parameter variations of instrument and Miniaturized Pointing Mount characteristics.

TM X-73375 April 1977
The Stress Corrosion Resistance and The Cryogenic Temperature Mechanical Properties of Hot Rolled Nitronic 32 Bar Material. J.W. Montano. Materials and Processes Laboratory. N77-21214

This report presents the ambient and cryogenic temperature mechanical properties and the ambient temperature stress corrosion properties of hot rolled and centerless ground Nitronic 32 stainless steel bar material.

The mechanical properties of longitudinal specimens were evaluated at test temperatures from ambient to liquid hydrogen. The tensile test data indicated increasing smooth tensile strength with decreasing temperature to liquid hydrogen temperature. However, below -200°F (-129.0°C) the notched tensile strength decreased slightly and below -320°F (-196.0°C) the decrease was significant. The elongation and reduction of area decreased drastically at temperatures below -200°F (-129.0°C). The Charpy V-notched impact energy decreased steadily with decreasing test temperature.

Stress corrosion tests were performed on longitudinal tensile specimens stressed to 0, 75, and 90% of the 0.2% yield strength and on transverse "C"-ring specimens stressed to 75 and 90% of the yield strength and exposed to: alternate immersion in a 3.5% NaCl bath, humidity cabinet environment, and a 5% salt spray atmosphere. The longitudinal tensile specimens experienced no corrosive attack; however, the "C"-rings exposed to the alternate immersion and to the salt spray, experienced some shallow etching and pitting, respectively. Small cracks appeared in two of the "C"-rings after one month

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exposure to the salt spray. Metallographic examination did not reveal the branching phenomenon associated with stress corrosion cracking.

TM X-73376 February 1977
Observation of the X-Ray Source Sco
X-1 from Skylab. Robert. M. Wilson.
Space Sciences Laboratory. N77-22021

An attempt was made to observe the discrete X-ray source Sco X-1 with ATM instrumentation on 20 September 1973 between 0856 and 0920 UT. This report presents the results of analysis of the X-ray data obtained with the ATM/S-056 X-ray event analyzer, in particular the flux observed with the 1.71 to 4.96 keV counter. No photographic image of the source was obtained because Sco X-1 was outside the field of view of the X-ray telescope.

TM X-73377 January 1977
The Contribution of Interstellar
Particles to the Interplanetary Dust
Complex. Gilmer Allen Gary. Space
Sciences Laboratory. N77-24038

The Poynting-Robertson effect acting on interstellar particles passing by the Sun was shown to have the potential to capture and possibly to contribute some of these particles to the interplanetary dust complex. When the probability of encounter of the Sun with interstellar clouds is considered, the quasi-equilibrium mass rate of accretion by this mechanism is comparable to the mass loss rate of the interplanetary complex. The mechanism then produces a quasi-equilibrium condition to maintain the interplanetary particle complex. This requires that the interstellar particles have a repulsive force due to radiation pressure less than the attractive gravitational force. If this assumption is correct for a significant fraction of

the particles, then at intervals an interstellar cloud may pass sufficiently close to the Sun to allow the Poynting-Robertson effect to replenish the interplanetary complex.

The previously proposed mechanisms of gravitational encounters and the solar gravitational lens as a method of capture of interstellar particles are shown to be insufficient. Corrections to the formulations of these two methods are given, and a closed form formula of the Poynting-Robertson effect on hyperbolic orbits about a star is derived.

TM X-73378 February 1977
Techniques of Global Analysis Applied
to Gravitation Theories: A Cosmologi-
cal Black Hole? George Debney. Space
Sciences Laboratory. N77-22029

An elementary model of freely falling observers and emitters within a black hole's radius is examined to determine the redshift spectrum reaching a typical observer. The model is independent of scale, the fundamental unit being the radius (mass) of the black hole. The observers/emitters all follow the same kinds of trajectories: radially inward and starting from rest at spatial infinity. The "test-particle" role is assumed throughout; i.e., the observers/emitters do not themselves contribute to the gravitational field of the system. By means of redshift formulas and luminosity distance to the emitters, a picture of actual redshifts and blueshifts, with their intensities, emerges for an observer within the black hole's radius. No luminosity distances greater than approximately one-half the radius are considered in this particular study; nevertheless, redshifts and blueshifts up to approximately 0.6 are seen in portions of the observer's celestial sphere (i.e., his sky). An exotic application can be made, as a

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curiosity, to a black hole the size of the universe, resulting in a particular anisotropic "cosmology."

TM X-73379 February 1977
The Application of Digital Techniques to the Analysis of Metallurgical Experiments. Thomas J. Rathz. Space Sciences Laboratory. N77-23239

The application of a specific digital computer system (known as the Image Data Processing System) to the analysis of three NASA-sponsored metallurgical experiments is discussed in some detail. Some of the basic hardware and software components of the Image Data Processing System are presented as deemed necessary for the understanding of the text. Many figures are presented in the discussion of each experimental analysis in an attempt to show the accuracy and speed that the Image Data Processing System affords in analyzing photographic images dealing with metallurgy, and in particular with material processing.

TM X-73380 February 1977
Bulk and Thin Films of FeTe: A Mössbauer Study. W. T. Escue, Kamna Aggarwal, and R. G. Mendiratta. Electronics and Control Laboratory. N77-23965

Bulk and thin films of FeTe have been studied Mössbauer spectroscopically. It was found that FeTe has one noncubic Fe^{2+} site which is $3d^2 4s 4p^3$ hybridized. The presence of dangling bands is indicated in spectra of FeTe thin films. The films show a tendency of texture formation. The substrate is observed to influence the film structure and nature of bonds in films.

TM X-73390 April 1977
Investigations for the Improvement of Space Shuttle Main Engine Electronic Beam Welding Equipment. R. A. Smock, R. A. Taylor, and W. A. Wall. Materials and Processes Laboratory. N77-23491

This report summarizes the progress made in the testing, evaluation, and correction of MSFC's 7.5 kW Electron Research, Incorporated (ERI) Electron Beam Welder in support of Space Shuttle Main Engine component welding at Rocketdyne in Canoga Park, California.

The objective of this project was to locate and correct the deficiencies in MSFC's 7.5 kW ERI electron beam welder and coordinate with Rocketdyne all data that would help to eliminate similar problems with their ERI equipment.

This report describes 17 areas that were deficient in the 7.5 kW ERI welding system, or checkout, and the associated corrective action taken to improve its operational performance.

The areas investigated during this project are not all inclusive but each particular modification or preventive measure provided a definite improvement in system performance. An overall improvement of 20 times the original reliability has been obtained at full rated capacity.

TM X-73391 April 1977
HEAO-A Nominal Scanning Observation Schedule. G. J. Fishman and R. L. Stone. Space Sciences Laboratory. N77-23163

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The High Energy Astronomy Observatory-A (HEAO-A) observatory, scheduled for launch in late June 1977, will spend most of its orbital lifetime in a scanning mode, spinning from 0.03 to 0.1 rpm about an axis aligned with the Sun. The dates of availability in the scan band are given for a list of 248 X-ray sources. Celestial maps of source locations and scan planes, and examples of the nighttime elevation of available sources are presented. This document is intended to aid ground-based observers in planning coordinated observations with HEAO-A.

TM X-73392 April 1977
An Analytical and Experimental Investigation of a 1.8 by 3.7 Meter Fresnel Lens Solar Concentrator. Leon J. Hastings, Steve L. Allums, and Warren S. Jensen. Structures and Propulsion Laboratory. N77-24582

Line-focusing acrylic Fresnel lenses with application potential in the 200° to 370° C range are being analytically and experimentally evaluated. Investigations previously conducted with a 56 cm wide lens have been extended by the present study to experimentation/analyses with a 1.8 by 3.7 m lens. A measured peak concentration ratio of 64 with 90 percent of the transmitted energy focused into a 5.0 cm width was achieved. A peak concentration of 61 and a 90 percent target width of 4.5 cm were analytically computed. The experimental and analytical lens transmittance was 81 percent and 86 percent, respectively. Thus, the analytical/experimental lens performance correlation is considered good. The lens also was interfaced with a receiver assembly and operated in the collection mode. The collection efficiency ranged from 42 percent at 100°C to 26 percent at 300°C, whereas an efficiency of 40 percent at 300°C was

anticipated. Apparently, the reflective cavity surrounding the absorber tube did not perform as expected. Therefore, future receiver assemblies will decrease or eliminate reliance on reflective surfaces; i.e., the energy focused directly on the absorber tube surfaces will be increased. Efficiency improvements to the 40 to 50 percent range are anticipated.

TM X-73393 May 1977
Apollo Telescope Mount — A Partial Listing of Scientific Publications and Presentations, Supplement 1. Edited by John M. Reynolds and William C. Snoddy. Space Sciences Laboratory. N77-24495

This report supplements NASA TM X-73300, April 15, 1976. These reports are compilations of bibliographies from the principal investigator groups of the Apollo Telescope Mount (Skylab solar observatory facility) that gathered data from May 28, 1973, to February 8, 1974. The analysis of these data is presently under way and is expected to continue for several years.

The publications listed in this report are divided into the following categories: (1) Journal Publications, (2) Journal Publications Submitted, (3) Other Publications, (4) Presentations — National and International Meetings; and (5) Other Presentations. An author index is included together with errata for the first report.

TM X-73394 April 1977
Orbit Transfer Systems with Emphasis on Shuttle Applications — 1986-1991. Program Development. N77-26198

The problems of orbit transportation have been addressed significantly during the past 5 years. An Interim Upper Stage (IUS)

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and a Spinning Solid Upper Stage (SSUS) are being developed for operation in the early 1980's. Current long-range planning efforts indicate a need for extended space operations capabilities which are greater than that provided by IUS and SSUS.

This is a system study for a transportation system which will follow the IUS and SSUS. Included are concepts, concept comparisons, trends, parametric data, etc. associated with the future system. Relevant technical and programmatic information is developed. This information is intended to focus future activity to identify attractive options and to summarize the major issues associated with the future development of the system. A comprehensive summary of the study is included in the body of the report in section XVI.

It is primarily the developing need for Earth synchronous orbit capabilities which gives cause for further consideration of orbital transportation systems at this time. Transportation needs for manned and unmanned synchronous orbit systems are foreseen. Total recoverability and reusability with minimum refurbishment are goals for future orbit transport systems.

To establish a common basis for identifying current transportation concepts, an Orbit Transfer Vehicle (OTV) is defined as a propulsive (velocity producing) rocket or stage. When used with a crew transfer module, a manned sortie module or other payloads, the combination becomes an Orbit Transfer System (OTS). Standardization of OTV's and OTS's is required.

TM X-73395 April 1977
Development of a Slicing Device for
Apollo-Soyuz Test Project (ASTP)
Electrophoresis Technology Experiment

MA-011. B. H. Nerren. Space Sciences
Laboratory. N77-24207

The electrophoresis of six columns was accomplished on the Apollo-Soyuz Test Project (ASTP). After separation, these columns were frozen in orbit and were returned for ground-based analyses. One major goal of the MA-011 experiment was the assessment of the separation achieved in orbit by slicing these frozen columns. The slicing of the frozen columns required a new device, and this report describes the development of that device.

TM X-73396 April 1977
HEAO-A Observatory Description.
Carroll Dailey and Thomas A. Parnell.
HEAO Office. N77-25207

This report presents an abbreviated description of the High Energy Astronomy Observatory (HEAO-A) Program, including spacecraft subsystems, scientific instrumentation, and the mission operations concept. Also, scientific participants such as Principal Investigators and Co-investigators are presented. This report is prepared as an aid to HEAO Guest Observers. Most of the material relating to the scientific instruments has been supplied by the investigators.

TM X-73397 April 1977
Handbook of Estimating Data, Factors,
and Procedures. Leonard M. Freeman.
Systems Analysis and Integration
Laboratory. N77-27248

This handbook seeks to fulfill the need for a book or collection of aids to assist in estimating cost. It contains a description of a work breakdown structure and briefly treats the necessity of analyzing the requirements for a cost element. A part of the handbook is devoted to standards for

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specific production type standards and to an assemblage of "factors" which can be applied to manufacturing or production cost for determining associated costs.

TM X-73398 July 1977
Solar Energy Bibliography. Compiled
by Stephen Gargus.

This document consists of listings of technical briefs, reports, and papers pertaining to research being performed by MSFC personnel and contractors in the field of solar energy.

TM 78120 September 1977
Power Supply Sharing in the Apollo
Telescope Mount Electrical Power
System. Roy Lanier, Jr. and Robert
Kapustka. Electronics and Control
Laboratory.

This report presents a new type of modular dc power supply power sharing technique that was developed for the Apollo Telescope Mount (ATM) electrical power system on the Skylab. The advantages and disadvantages of various techniques used in the past are reviewed and compared to the new method. The new technique design is discussed, and results of its implementation in the ATM power system are reviewed.

TM-78121 July 1977
PACE II – Pricing and Cost Estimating
Handbook. Rodney D. Stewart and
Tom Shepherd. Systems Analysis and
Integration Laboratory. N77-29801

In early 1973 the Marshall Space Flight Center (MSFC) initiated an effort to develop and establish an automatic data processing system to be used primarily for the preparation of industrial-engineering-type manhour-and-material cost estimates. This

computer system, termed PACE (Pricing and Cost Estimating), was established and has evolved over the past several years through the PACE I and PACE II systems into a highly versatile and highly flexible tool which significantly reduces computation time, eliminates computational errors, and reduces typing and reproduction time for estimators and pricers. Because this system makes all mathematical and clerical functions automatic once basic inputs are derived, the time of estimators, estimate managers, secretarial personnel, and engineers involved in the estimating and cost analysis process can be devoted to publication of ground rules, and collection, analysis, and adjustment of inputs and rationale. This system also reduces the manhours required for manual computations and documentation.

This handbook has been prepared to facilitate use by those not familiar with the PACE II system or with detailed automatic data processing techniques; therefore, an attempt has been made to be explanatory and specific in all areas where actions are required to implement and activate the system. (The PACE I system is described in detail in TM X-73325.)

TM-78122 July 1977
Film Calibration for the Skylab/ATM
S-056 X-Ray Telescope. William Henze,
Jr., Robert M. Broussard, James H.
Underwood, James P. McGuire, Edwin
J. Reichmann, and Jesse B. Smith, Jr.
Space Sciences Laboratory. N77-29038

The sensitometry and film calibration effort for the NASA-MSFC/The Aerospace Corporation Skylab/ATM S-056 X-Ray Telescope is summarized. The apparatus and procedures used by Sperry/MSFC and by Aerospace Corporation are described

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together with the two types of flight film used, Kodak SO-212 and SO-242. The sensitometry and processing of the flight film are discussed, and the results are presented in the form of the characteristic curves and related data. The use of copy films is also discussed.

TM-78123 April 1977
A Preliminary Investigation of the Environmental Control and Life Support Subsystem (EC/LSS) for the Space Construction Base Manufacturing Modules. Hubert B. Wells. Preliminary Design Office. N77-29788

This report presents the preliminary Prephase A data of the Environmental Control and Life Support Subsystem (EC/LSS) for a typical Space Construction Base manufacturing module. A space processing module, which is capable of performing production biological experiments, was chosen as a baseline configuration.

The module would be manned approximately 12 h/day by a crew of two (an engineer and technician). By assuming a three-man maximum capacity, consideration can be given to the use of existing EC/LSS assemblies such as Spacelab, Orbiter, or Regenerative Life Support Evaluation (RLSE). Spacelab assemblies were given preference because of their later production schedule. The primary Spacelab assemblies and components considered for use are humidity and temperature control, ventilation fan, cabin fan, water separator, condensate storage, overboard dumping, distribution system, contaminant monitoring, cabin sensors, and fire and smoke detection. Carbon dioxide removal, atmospheric supply, and pressure control are furnished by the Habitability Module/Subsystems Module.

Contaminant control is accomplished by the RLSE contaminant control assembly.

TM-78124 June 1977
Multipurpose Interactive NASA Information System (MINIS). Data Systems Laboratory. N77-28987

The Multipurpose Interactive NASA Information System (MINIS) was developed to provide remote, interactive information retrieval capability for various types of data bases to be processed on different types of small and medium size computers.

This report presents to the layman user an explanation of how to use the system for three different data bases: (1) Landsat Photo Look-Up, (2) Land-Use, and (3) Census/Socio-Economic. Each of the data base elements is shown together with other detailed information that a user would require to contact the system remotely, to transmit inquiries on commands, and to receive the results of the queries or commands.

TM-78127 August 1977
Instrument Concept for Geophysical Fluid Flow Experiments on the First Spacelab Mission. Richard S. Rodkin and George H. Fichtl. Space Sciences Laboratory. N77-29448

A concept is provided for a Geophysical Fluid Flow Cell (GFFC). Sufficient detail is given to allow the start of a GFFC design effort. A brief background of the scientific studies to be conducted with the GFFC and the theoretical basis for GFFC operation are also included.

TM 78128 July 1977
Some Basic Mathematical Methods of Diffusion Theory. A. C. Giere. Space Sciences Laboratory.

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An introductory treatment of the fundamentals of diffusion theory is presented, starting with molecular diffusion and leading up to the statistical methods of turbulent diffusion. The concepts and equations of diffusion are developed on an elementary level, with emphasis on atmospheric applications.

TM-78129 July 1977

Preliminary Assessment of the Vacuum Environment in the Wake of Large Space Vehicles. W. A. Oran and R. J. Naumann, Space Sciences Laboratory.

The vacuum environment in the wake region of presently planned large space vehicles is calculated using simplified models of the particle fluxes from the various sources. The fluxes which are calculated come directly from the ambient, are due to ambient particles backscattered from spacecraft emissions, and are due to self-scattering of spacecraft emissions. Using nominal values for the surface emissions, the flux density environment behind a large unmanned craft at 550 km altitude is calculated at $\sim 10^7/\text{cm}^2 \text{ s}$. For an experiment involving rapid physical deposition of vaporized material, this may result in contamination levels of < 1 part in 10^9 occurring in the bulk material. Calculations indicate that the flux density on a wake vacuum experiment conducted in the vicinity of the Shuttle will be substantially greater than that behind unmanned craft. However, it is possible that, under appropriate circumstances, meaningful wake vacuum experiments still could be conducted using the Shuttle facilities.

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TN D-8322

July 1976

Post Sunset Behavior of the 6300 Å Atomic Oxygen Airglow Emission.
Robert E. Smith. Space Sciences Laboratory.
N77-10732

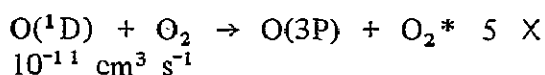
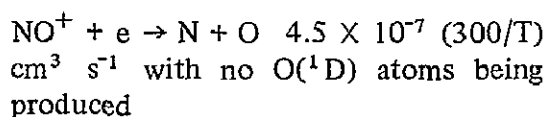
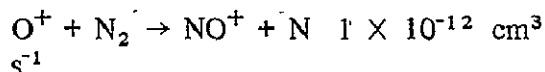
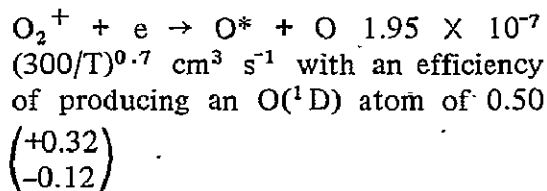
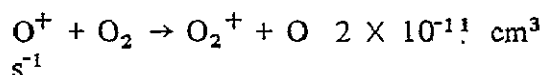
A theoretical model of the 6300 Å OI airglow emission has been developed based on the assumptions that both the charged and neutral portions of the Earth's upper atmosphere are in steady state conditions of diffusive equilibrium. Intensities of the 6300 Å OI emission line have been calculated using electron density-true height profiles from a standard C-4 ionosonde and exospheric temperatures derived from Fabry-Perot interferometer measurements of the Doppler-broadened 6300 Å emission line shape as inputs to the model. Reaction rate coefficient values, production mechanism efficiencies, solar radiation fluxes, absorption cross sections, and models of the neutral atmosphere have been varied parametrically to establish a set of acceptable inputs which will consistently predict 6300 Å emission intensities that closely agree with intensities observed during the post-sunset twilight period by an airglow observatory consisting of a Fabry-Perot interferometer and a turret photometer.

Emission intensities that can only result from the dissociative recombination of molecular oxygen ions were observed during the latter portion of the observational period. They were used with limiting values, taken from the literature, of the quenching coefficients and the production mechanism efficiencies to establish a representative model of the atmosphere. Based on current knowledge of the nearby hydroxyl bands and the configuration of the equipment used to obtain the observational data, theoretical calculations indicate that contamination of the 6300 Å OI emission should be on the

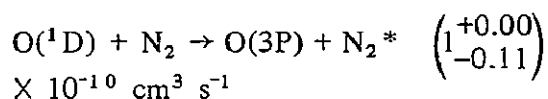
order of or less than 3 percent; however, these results are very sensitive to the wavelengths of the individual lines and their intensities relative to the 6300 Å OI intensity.

The combination of a model atmosphere, production mechanism efficiencies, and quenching coefficient values was used during the earlier portion of the period when the dissociative photoexcitation and direct impact excitation processes were contributing to the intensity to establish best estimates of solar radiation fluxes in the Schumann-Runge continuum and associated absorption cross sections.

Results of this analysis show that the Jacchia 1971 model of the upper atmosphere combined with the Ackerman (1970) recommended solar radiation fluxes and associated absorption cross sections produces theoretically calculated intensities that more closely agree with the observed intensities than all the other combinations when the following set of reaction rate coefficients and efficiencies is used:



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However, the analysis showed that the third source of O(¹D) atoms, by conjugate point photoelectrons, contributed significantly to the overall observed intensity during the early portion of the post-sunset twilight period with the contribution decreasing with increasing conjugate point solar zenith angle. No O(¹D) atoms were produced by this mechanism after conjugate point sundown, assuming a screening height of 180 km. when the conjugate point solar zenith angle was approximately 103°.

TN D-8366 November 1976
The Theoretical Reflectance of X-Rays from Optical Surfaces. John R. Neergaard, John M. Reynolds, and Stanley A. Fields. Space Sciences Laboratory. N77-11853

The theoretical reflectance of X-rays from various materials and evaporated films is presented. A computer program has been written that computes the reflected intensity as a function of the angle of the incident radiation. The quantities necessary to generate the efficiency and their effect on the data are demonstrated. Five materials were chosen for evaluation: (1) fused silica, (2) chromium, (3) beryllium, (4) gold, and (5) a thin layer contaminant. Fused silica is a versatile and common material; chromium has high reflection efficiency at X-ray wavelengths and is in the middle of the atomic number range; beryllium contains a single atomic shell and has a low range atomic number; gold contains multiple atomic shells and has a high atomic number; the contaminant is treated as a thin film in the calculations and results are given as a function of thickness for selected wavelengths. The theoretical results are compared to experimental data at $\lambda = 8.34 \text{ \AA}$.

TN D-8409 February 1977
Corrosion Inhibitors for Solar Heating and Cooling Systems. T. S. Humphries and G. E. DeRamus, Jr. Materials and Processes Laboratory. N77-17198

Problems dealing with corrosion and corrosion protection of solar heating and cooling systems are discussed. A test program was conducted to find suitable and effective corrosion inhibitors for systems employing either water or antifreeze solutions for heat transfer and storage. Aluminum-mild steel-copper-stainless steel assemblies in electrical contact were used to simulate a multimetallic system which is the type most likely to be employed. Several inhibitors show promise for this application.

TN D-8420 February 1977
A Procedure Used for a Ground Truth Study of a Land Use Map of North Alabama Generated from Landsat Data. Sanford W. Downs, Jr., G. C. Sharma, and Colin Bagwell. Data Systems Laboratory. N77-17550

A land use map of a five county area in North Alabama was generated from Landsat data using a supervised classification algorithm. There was good overall agreement between the land use designated and known conditions, but there were also obvious discrepancies. In ground checking the map, two types of errors were encountered — shift and misclassification — and a method was developed to eliminate or greatly reduce the errors. Randomly selected study areas containing 2525 pixels were analyzed. Overall, 76.3 percent of the pixels were correctly classified. A contingency coefficient of correlation was calculated to be 0.7 which is significant at the $\alpha = 0.01$ level. The study showed that land use maps generated by computers from Landsat data are useful for overall land use by regional

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agencies. However, care must be used when making detailed analysis of small areas.

The procedure used for conducting the ground truth study together with data from representative study areas is presented in this report.

TN D-8429 February 1977
Laser Doppler Dust Devil Measurements. James W. Bilbro, Harold B. Jeffreys, John W. Kaufman, and Edwin A. Weaver. Electronics and Control Laboratory. N77-18658

A Scanning Laser Doppler Velocimeter (SLDV) system was employed at a test site on the Gila River Indian Reservation south of Phoenix, Arizona, for the purpose of detecting, tracking, and measuring the velocity flow field of naturally occurring tornado-like flows (dust devils) in the atmosphere. Approximately 80 dust devils were observed with the system during the test period from August 10 through August 16, 1975. This report provides a review and general description of the dust devil phenomenon and outlines the test program, measurement system, and data processing techniques used to collect information on the dust devil flow field. The general meteorological conditions occurring during the test program are also described, and the information collected on two selected dust devils are discussed in some detail to show the type of information which can be obtained with a SLDV system. The results from these measurements agree well with those of other investigators and illustrate the potential for the SLDV in future endeavors; consequently, recommendations are given for a comprehensive test program using a variety of sensors for obtaining a more complete description of the dust devil phenomenon.

TN D-8435 February 1977
Evaluation of Quasi-Square Wave Inverter as a Power Source for Induction Motors. Buddy V. Guynes, Roger L. Haggard, and John R. Lanier, Jr. Electronics and Control Laboratory. N77-18559

This study investigates the relative merits of quasi-square wave inverter-motor technology versus a sine wave inverter-motor system. The empirical results of several tests on various sizes of wye-wound induction motors are presented with mathematical analysis to support the conclusions of this study. This study concludes that, within the limitations presented in this report, the quasi-square wave inverter-motor system is superior to the more complex sine wave system for most induction motor applications in space.

TN D-8445 March 1977
An Investigation of the Temporal Character of Mesoscale Perturbations in the Troposphere and Stratosphere. William W. Vaughan. Space Sciences Laboratory. N77-18661

The purpose of this investigation was to assess the effectiveness of mesoscale models in explaining perturbations observed in vertical detailed wind profile measurements in the troposphere and lower stratosphere. The structure and persistence of the data were analyzed and interpreted in terms of several physical models with the goal of establishing explanations for the observed persistent features of the mesoscale flow patterns.

The experimental data used in the investigation were obtained by a unique detailed wind profile measurement system.

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This system is capable of providing resolution of 50 to 100 m wavelengths for the altitude region from approximately 200 m to 18 km. The system consists of a high-resolution tracking radar and special super-pressure balloon configuration known as a Jimsphere.

TN D-8450 March 1977
Development of Flat Conductor Cable
for Commercial and Residential Wiring
— Final Report. James R. Carden.
Electronics and Control Laboratory.
N77-20342

The overall spectrum of the George C. Marshall Space Flight Center's (MSFC) total effort in a space technology spin-off development project, Development of Flat Conductor Cable (FCC) for Commercial and Residential Wiring, is presented in this report. A discussion of the background, program milestones, industry participants, system outgrowth, hardware availability, cost estimates, and overall status of the program is presented for the 1970-to-present time period. Although the artwork presents detailed information, it is intended that the reader obtain more detailed information from the reports presented in Sections III and IV.B.

TN D-8508 June 1977
A Nickel-Cadmium Battery Reconditioning Circuit. Roy Lanier. Electronics and Control Laboratory. N77-25630

The circuit presented in this paper is simple and small enough to be included in a typical battery charge/power control assembly, yet provides the advantage of a complete "ground-type" battery reconditioning discharge. Test results on the circuit when used to recondition two 24 cell, 20 A-h nickel-cadmium batteries are given.

These results show that a battery reconditioned with this circuit returns to greater than 90 percent of its original capacity (greater than nameplate capacity) and follows a typical new battery degradation curve even after over 20 000 simulated orbital cycles for a 4 year period.

This report addresses applications of the circuit and makes recommendations relative to its use. Its application in low voltage (22 to 36 Vdc) power systems and in high voltage (100 to 150 Vdc) power systems is discussed. The implications are that the high voltage systems have a greater need for battery reconditioning than its low voltage counterpart, and that using these circuit techniques, the expected life of a battery in low Earth orbit can be up to 5 years.

TN D-8511 June 1977
Materials and Processes for Shuttle
Engine, External Tank, and Solid
Rocket Booster. R. J. Schwinghamer.
Materials and Processes Laboratory.
N77-25219

The Space Shuttle will provide a low cost delivery system for Earth orbital payloads by amortizing launch costs through system reusability. The Shuttle flight system is composed of the Orbiter, an External Tank (ET) that contains the ascent propellant to be used by the Space Shuttle Main Engines (SSME), and two Solid Rocket Boosters (SRB). The ET is expended on each launch; the Orbiter and SRB's are reusable. It is the requirement for reuse which poses the exciting new materials and processes challenges in the development of the Space Shuttle. This report deals with the materials and processes for the SSME, the ET, and the SRB. A brief description of the Space Shuttle and the mission profile is

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given. The Shuttle configuration is then described with emphasis on the SSME, ET, and SRB. The materials selection, tracking, and control system used to assure reliability and to minimize cost are described, and salient features and challenges in materials and processes associated with the SSME, ET, and SRB are subsequently discussed.

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TP-1005

August 1977

An Analytical and Experimental Investigation of a 1.8 by 3.7 Meter Fresnel Lens Solar Concentrator. Leon J. Hastings, Steve L. Allums, and Warren S. Jensen. Structures and Propulsion Laboratory.

Line-focusing acrylic Fresnel lenses with application potential in the 200° to 370°C range are being analytically and experimentally evaluated. Investigations previously conducted with a 56 cm wide lens have been extended by the present study to experimentation/analyses with a 1.8 by 3.7 m lens. A measured peak concentration ratio of 64 with 90 percent of the transmitted energy focused into a 5.0 cm width was achieved. A peak concentration of 61 and a 90 percent target width of 4.5 cm were analytically computed. The experimental and analytical lens transmittance was 81 percent and 86 percent, respectively. Thus, the analytical/experimental lens performance correlation is considered good. The lens also was interfaced with a receiver assembly and operated in the collection mode. The collection efficiency ranged from 42 percent at 100°C to 26 percent at 300°C, whereas an efficiency of 40 percent at 300°C was anticipated. Apparently, the reflective cavity surrounding the absorber tube did not perform as expected. Therefore, future receiver assemblies will decrease or eliminate reliance on reflective surfaces, i.e., the energy focused directly on the absorber tube surfaces will be increased. Efficiency improvements to the 40 to 50 percent range are anticipated.

TP-1016

August 1977

Concept Report: Microprocessor Control of Electrical Power System. Eugene Perry. Electronics and Control Laboratory.

To meet the predicted requirements for future programs, it is necessary that new and improved concepts for electrical power generation, conversion, and distribution be developed. The power system should be reuseable and capable of short turn-around times over several missions. Other constraints imposed on the power conversion system include minimum weight and volume, and no single-point failure that will result in a system failure. This report describes the use of microprocessor controllers in space power systems to meet these requirements.

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TR R-465 July 1976
High and Low Threshold P-Channel
Metal Oxide Semiconductor Process and
Description of Microelectronics Facility.
David L. Bouldin, William R. Feltner,
Ben R. Hollis, and Donald E. Routh.
Electronics and Control Laboratory.

The fabrication techniques and detail procedures for creating P-channel Metal-Oxide-Semiconductor (P-MOS) integrated circuits at George C. Marshall Space Flight Center (MSFC) are described. Examples of P-MOS integrated circuits fabricated at MSFC together with functional descriptions of each are given. Typical electrical characteristics of high and low threshold P-MOS discrete devices under given conditions are provided. A general description of MSFC design, mask making, packaging, and testing procedures is included.

The capabilities described in this report are being utilized in: (1) research and development of new technology, (2) education of individuals in the various disciplines and technologies of the field of microelectronics, and (3) fabrication of many types of specially designed integrated circuits which are not commercially feasible in small quantities for in-house research and development programs.

TR R-469 October 1976
The Eigenvalue Spectrum of the
Orr-Sommerfeld Problem. Basil N.
Antar. Space Sciences Laboratory.
N77-11344

A numerical investigation of the temporal eigenvalue spectrum of the Orr-Sommerfeld equation is presented. Two flow profiles are studied, the plane Poiseuille flow profile and the Blasius boundary layer

(parallel) flow profile. In both cases a portion of the complex c -plane bounded by $0 \leq c_r \leq 1$ and $-1 \leq c_i \leq 0$ is searched and the eigenvalues within it are identified. The spectra for the plane Poiseuille flow at $\alpha = 1.0$ and $R = 10^2, 10^3, 6 \times 10^3$, and 10^4 are determined and compared with existing results where possible. The spectrum for the Blasius boundary layer flow at $\alpha = 0.308$ and $R = 998$ was found to be infinite and discrete. Other spectra for the Blasius boundary layer at various Reynolds numbers seem to confirm this result. The eigenmodes belonging to these spectra were located and discussed.

TR R-473 June 1977
Rocket Exhaust Effluent Modeling for
Tropospheric Air Quality and Environ-
mental Assessments. J. Briscoe Stephens
and Roger B. Stewart. Space Sciences
Laboratory. N77-25456

The various techniques for diffusion predictions to support air quality predictions and environmental assessments for aerospace applications are discussed in terms of limitations imposed by atmospheric data. This affords an introduction to the rationale behind the selection of the National Aeronautics and Space Administration (NASA)/Marshall Space Flight Center (MSFC) Rocket Exhaust Effluent Diffusion (REED) program. The models utilized in the NASA/MSFC REED program are explained. This program is then evaluated in terms of some results from a joint MSFC/Langley Research Center/Kennedy Space Center Titan Exhaust Effluent Prediction and Monitoring Program.

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Analysis of Structural Dynamic Data from Skylab Volume I — Technical Discussion. Leonard Demchak and Harry Harcrow. NAS8-31224. Martin Marietta Corporation. N77-10114
- CR-2728 August 1976
Analysis of Structural Dynamic Data from Skylab Volume II — Skylab Analytical and Test Modal Data. Leonard Demchak and Harry Harcrow. NAS8-31224. Martin Marietta Corporation. N76-33251
- CR-2749 October 1976
Turbulent Atmospheric Flow over a Backward-Facing Step. U. K. Kaul and Walter Frost. NAS8-29584. The University of Tennessee Space Institute. N77-12639
- CR-2750 October 1976
Atmospheric Flow Over Two-Dimensional Bluff Surface Obstructions. Juergen Bitte and Walter Frost. NAS8-29584. The University of Tennessee Space Institute. N77-11996
- CR-2751 October 1976
Estimates of the Low-Level Wind Shear and Turbulence in the Vicinity of Kennedy International Airport on June 24, 1975. W. S. Lewellen, Guy G. Williamson, and M. E. Teske. NAS8-31380. Aeronautical Research Associates of Princeton, Inc. N76-33139
- CR-2752 October 1976
Wind Shear and Turbulence Around Airports. W. S. Lewellen and Guy G. Williamson. NAS8-31380. Aeronautical Research Associates of Princeton, Inc. N76-33140
- CR-2753 October 1976
Studies of Earth Simulation Experiments. John E. Hart. NAS8-31149. Massachusetts Institute of Technology. N76-33817
- CR-2755 October 1976
Electrophoretic Characterization of Aldehyde-Fixed Red Blood Cells, Kidney Cells, Lymphocytes and Chamber Coatings. Robert J. Knox. NAS8-30887. University of Oregon Health Sciences Center. N77-10539
- CR-2756 October 1976
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Effects of Fog Droplets on Wake Vortex Decay Rate. T. H. Moulden and Walter Frost. NAS8-29584. The University of Tennessee Space Institute. N76-33166
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Preliminary Study of Contaminant Particulates around Skylab. D. W. Schuerman and J. L. Weinberg. NAS8-31902. State University of New York at Albany. N77-10975

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21140. The Pennsylvania State
University. N77-15581

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The University of Alabama in Hunts-
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J. Kiusalaas and G. B. Reddy.
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CR-2796 February 1977
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CR-2797 March 1977
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State University. N77-18472

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J. Kiusalaas and G. B. Reddy.
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| netic Field. Submitted to the JGR. | | Orlando, Florida. | |
| HORWITZ, J. L. | ES53 | JEAN, OTHA C. | JA01 |
| DOUPNIK, J. R. | Utah State University | LESTER, ROY | JA01 |
| BANKS, P. M. | Utah State University | Integration of Shuttle Payloads. | |
| KAMIDE, Y. | University of Colorado | Published in Astronautics and Aero- | |
| | | navics. | |

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

JOHNSON, C. W.	PF03	KIEFLING, LARRY	ED23
LUNDQUIST, C. A.	ES01	SPAR	October 18-20, 1977. Presentation at the 48th Shock and Vibration Symposium to be held at Huntsville, Alabama.
ZURASKY, J. L.	EC32		
The Lageos Satellite.	October 10-16, 1976. Presentation at the XXVIIth International Astronautical Congress to be held at Anaheim, California.		
JOHNSTON, MARY HELEN	EH22	KRALL, K. R.	ES52
Dendrite Remelting and Macrosegregation Experiment.	April 20-21, 1977. Presentation at the Applications of Space Flight in Materials Science and Technology Conference to be held at Gaithersburg, Maryland.	REICHMANN, E. J.	ES52
		WILSON, R. M.	ES52
		HENZE, W.	ES52
		SMITH, J. B.	ES52
		Analysis of X-Ray Observations of the 15 June 1973 Flare in Active Region NOAA 131. Submitted to Solar Physics.	
JONES, CHARLES O.	EC32	KURTZ, ROBERT L.	ES83
Control of Optical Performance on the Space Telescope.	January 11, 1977. Presentation at the AIAA Thirteenth Annual Meeting to be held at Washington, D. C.	LIU, H. K.	University of Alabama A Practical Method for Holographic Interference Fringe Assessment. Published in Optical Engineering.
JONES, LEE W.	EP24	KROES, ROGER L.	ES74
The NASA Standard One-Pound Thruster.	July 11-13, 1977. Presentation at the AIAA/SAE 13th Propulsion Conference to be held at Orlando, Florida.	GEL	Growth of AgI Crystals. January 16-18, 1978. Presentation at the AIAA 16th Aerospace Sciences Meeting to be held at Huntsville, Alabama.
KENNEDY, R.	NASA Headquarters	LANIER, JOHN R.	EC13
PACE, R.	NASA/MSFC	A Circuit for Reconditioning Ni-Cd Batteries in Space.	June 14-16, 1977. Presentation at the Institute of Electrical and Electronics Engineers Conference to be held at Palo Alto, California.
COLLET, J.	ESA Headquarters, Paris France	LENNARTSSON, WALTER	ES53
SANFOURCHE, J. P.	ESA/SPICE, Porz-Wahn FRG	REASONER, DAVID L.	ES53
The First Spacelab Payload — A Joint NASA/ESA Venture.	September 26-October 1, 1977. Presentation at the XXVIIIth Congress of the International Astronautical Federation to be held at Prague, Czechoslovakia.	Low Energy Plasma Observations at Synchronous Orbit. Submitted to the Journal of Geophysical Research.	

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| LOGAN, EARL, JR. | ES82 | McKANNAN, EUGENE C. | PF11 |
| CAMP, DENNIS W. | ES82 | Space Processing Influences Materials Advances. May 9-12, 1977. Presentation at the International Engineering Conference and Tool and Manufacturing Exposition to be held at Detroit, Michigan. | |
| Preliminary Comparison of Model and Prototype Wakes. January 16-18, 1978. Presentation at the AIAA 16th Aerospace Sciences Meeting to be held at Huntsville, Alabama. | | | |
| LUCAS, W. R. | DA01 | MAYNARD, O. E. | Raytheon |
| The Promise of Space Processing. January 11-13, 1977. Presentation at the AIAA 13th Annual Meeting to be held at Washington, D. C. | | KATZ, A. H. | Raytheon |
| | | WHITACRE, W. E. | MSFC |
| LUNDQUIST, CHARLES A. | ES01 | Spaceborne Power Conversion Into a Microwave Beam and Its Impact on the Environment of the Upper Atmosphere. August 1977. Presentation at the IECEC Conference to be held at Washington, D. C. | |
| COLOMBO, GIUSEPPE | | | |
| Univ. of Padova, Padova, Italy | | MIDDLETON, ROBERT L. | FA33 |
| Advanced Technologies in Space and Opportunities for Gravity Experiments. August 24-September 4, 1977. Presentation at the International School of Relativistic Astrophysics meeting to be held at Erice, Trapani, Sicily. | | Commercial Solar Demonstration Program - Some Early Results. April 25-29, 1977. Presentation at the Civil Engineering in 21st Century Conference to be held at Dallas, Texas. | |
| LUNDQUIST, CHARLES A. | ES01 | | |
| SIEBEL, M. P. L. | ES01 | MILLER, RONALD I. | |
| COLEMAN, PAUL J. | | Boeing Aerospace Co. | |
| Univ. of California at Los Angeles | | JOHNSTON, MARY HELEN | EH12 |
| McLEOD, M. G. | | Gravitational Segregation in Alloy Melts. Submitted to the Journal of Materials Science. | |
| Univ. of California at Los Angeles | | | |
| Tethered Satellites for Magnetic Field Measurements. Published in the Proceedings of the NASA Workshop on Application of Space Techniques to Geodynamics. | | MOORE, W. WALDING, JR. | ES83 |
| | | KURTZ, ROBERT L. | ES83 |
| | | Electro-Optic and Holographic Measurement Techniques for Atmospheric Sciences. April 18, 1977. Presentation at the APIE/SPSE Technical Symposium to be held at Reston, Virginia. | |
| McKANNAN, EUGENE C. | PF11 | | |
| Experimental Capabilities: Skylab/Apollo Soyuz/Rocket. April 20-21, 1977. Presentation at the Applications of Space Flight In Materials Science and Technology Conference to be held at Gaithersburg, Maryland. | | NAUMANN, ROBERT J. | ES71 |
| | | Separation Processes in Low-Gravity: A Basis for Space Industrialization? | |

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- October 18-20, 1977. Presentation at the American Astronautical Society Conference to be held at San Francisco, California.
- NEIGHBORS, ALICE K. EE71
- REDDY, J. N.
- COST, T. L.
Dynamic Response of a Geometrically Nonlinear Composite Elastic/Viscoelastic Cylinder. May 27, 1977. Presentation at the CAN CAM conference to be held at Vancouver, British Columbia.
- NICHOLS, R. L. EH34
Glass Processing in Space. January 16-18, 1978. Presentation at the 16th AIAA Aerospace Sciences Meeting to be held at Huntsville, Alabama.
- O'DELL, C. R. DS30
- SWAMY, K. S. KRISHNA
Tata Institute of Fundamental Research
Statistical Equilibrium in Cometary C₂.
I. Published in the Astrophysical Journal.
- ORAN, W. A. ES72
- NAUMANN, R. J. ES71
Utilization of the Vacuum Developed in the Wake Zone of Space Vehicle of the LDEF Class. February 9-11, 1977. Presentation at the "Use of the Space Shuttle for Science and Engineering" Conference to be held at Ames Research Center, Mountain View, California.
- ORAN, W. A. ES72
- NAUMANN, R. J. ES71
Vacuum in the Wake of Space Vehicles. Published in Vacuum (published in London, England).
- PACE, ROBERT E. JA11
- CRAFT, HARRY G., JR. JA11
Planning for Early Spacelab Missions. April 27-29, 1977. Presentation at the 14th Space Congress to be held at Kennedy Space Center, Florida.
- PARR, R. A. EH22
- McCLURE, J. C. EH22
- JOHNSTON, M. H. EH22
Growth Parameters for Aligned Microstructures in Directionally Solidified Aluminum-Bismuth Monotectic. Submitted to Metallurgical Transactions.
- PERKINS, J. H. EH32
- RIEHL, W. A. EH31
Autoignition of Hydrazine by Engineering Materials. January 16-18, 1978. Presentation at the 16th AIAA Aerospace Sciences Meeting to be held at Huntsville, Alabama.
- PRIEST, CLAUDE C. PS04
Space Industrialization Studies - An Overview. May 9-11, 1977. Presentation at the AIAA Conference on Space Manufacturing to be held at Princeton, New Jersey.
- RAO, GOPALA ES52
- ASKINS, BARBARA S. ES52
Potential Reduction of X-Ray Exposure Through Autoradiographic Intensification of Underexposed Radiographs. July 31-August 4, 1977. Presentation at the 19th Annual Meeting of the American Association of Physicists in Medicine to be held at Cincinnati, Ohio.
- RATHZ, THOMAS J. ES74
The Application of Digital Techniques to the Analysis of Metallurgical

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(Available only from authors. Dates are clearance dates.)

Experiments. August 23-26, 1977. Presentation at the Symposium on Applications of Computer Methods in Engineering to be held at Los Angeles, California.

RAY, C. D. EP35
Investigation of Low Temperature Carbon Monoxide Oxidation Catalysts. July 11-14, 1977. Presentation at the 7th Intersociety Conference on Environmental Control to be held at San Francisco, California.

REICHMANN, E. J. ES52

HENZE, W., JR. ES52

WU, S. T. ES52
Discussion of Soft X-Ray and Ground Based Observations of NOAA 212 and 215. June 12-15, 1977. Presentation at the 150th Meeting of the AAS to be held at Atlanta, Georgia.

ROBERTS, MARION L. EH43
Processing of Selective Solar Collector Coatings. January 16-18, 1978. Presentation at the 16th AIAA Aerospace Science Meeting to be held at Huntsville, Alabama.

ROWE, D. W. General Electric

HOOPER, J. W. EF24
Data System Dynamic Simulation - A Total System for Data System Design Assessments and Trade Studies. March 15-17, 1978. Presentation at the Eleventh Annual Simulation Symposium to be held at Tampa, Florida.

SCHAFER, CHARLES F. ES12
SPAR I Liquid Mixing Experiment. January 24-26, 1977. Presentation at the AIAA 15th Aerospace Sciences

Meeting (AIAA Technical Committee for Space Processing) to be held at Los Angeles, California.

SCHLAGHECK, RONALD A. EL12
An Interactive Computer Approach to Performing Resource Analysis for a Multi-Resource/Multi-Project Problem. December 5-7, 1977. Presentation at the Winter Simulation Conference to be held at Gaithersburg, Maryland.

SCHWINGHAMER, ROBERT J. EH01
Materials and Processes for Shuttle Engine, External Tank, and Solid Booster. October 16, 1976. Presentation at the XXVII International Astronautical Congress to be held at Anaheim, California.

SCISSUM, JEANETTE A. ES83
Holography: A Tutorial for Laypersons. August 2-5, 1977. Presentation at the National Technical Association 49th Annual Convention to be held at Hampton, Virginia.

SCISSUM, JEANETTE A. ES83
Climatic Changes and Solar Activity. Published in NTA Journal.

SELTZER, S. M. ED12

SHELTON, H. L. ED12
Specifying Spacecraft Flexible Appendage Rigidity. August 8-10, 1977. Presentation at the AIAA 1977 Guidance and Control Conference to be held at Hollywood, Florida.

SHELTON, HARVEY L. ED12
Specifying Flexibly Body Constraints for Spacecraft with N-Modes. January 16-18, 1978. Presentation at the 16th AIAA Aerospace Sciences Meeting to be held at Huntsville, Alabama.

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(Available only from authors. Dates are clearance dates.)

SHURNEY, ROBERT E.	EL15	Soft X-Ray Manifestation of Coronal Transient-Related Events. June 7-17, 1977. Presentation at the COSPAR, XXth Plenary Meeting to be held at Tel Aviv, Israel.
KC-135 Zero-Gravity Aircraft Simulation Summary Report for 1976. January 16-18, 1978. Presentation at the 16th AIAA Aerospace Sciences Meeting to be held at Huntsville, Alabama.		
SIMS, JOSEPH L.	ED32	
BLACKWELL, KENNETH L.	ED32	
Base Pressure Correlation Parameters. June 7-8, 1977. Presentation at the Workshop on Missile and Plume Interaction Flow Fields to be held at Redstone Arsenal.		
SMITH, AUBREY D.	AT01	
Engineering and Productivity Gains from Space Technology. Submitted to NSPE Magazine.		
SMITH, JESSE B.	ES52	
Physical Parameters of a Solar Flare as Derived from Skylab X-Ray Data. Submitted to Astrophysical Journal (Letters).		
SMITH, J. B., Jr.	ES13	
SPEICH, D. M.	ES13	
WILSON, R. M.	ES13	
TANDBERG-HANSEN, E.	ES13	
WU, S. T.	ES13	
Prominence Mass Ejections and Their Effects on the Corona. I: The Eruptive Prominence of 21 August 1973 and the Surge of 4 December 1973. Submitted to Solar Physics.		
SMITH, J. B., JR.	ES52	
SPEICH, D. M.	ES52	
TANDBERG-HANSEN, E.	ES52	
WILSON, R. M.	ES52	
REICHMANN, E. J.	ES52	
		Univ. of Alabama in Huntsville
		Ray Tracing of Gravity Waves as a Possible Warning System for Tornadoic Storms and Hurricanes. Submitted to Monthly Weather Review.
SMITH, R. E.	ES44	
HUNG, RU J.		
SMITH, R. E.	ES81	
HUNG, R. J.	UAH	
Detection of Tornadoes by Doppler Sounder Techniques. Submitted to the Bulletin of the American Meteorological Society.		
SPEER, F. A.	HA01	
DAILEY, C. C.	HA01	
HEAO-A - The First High Energy Astronomy Observatory. February 7, 1978. Presentation at the AIAA 14th Annual Meeting to be held at Washington, D. C.		
SPENCER, ROBERT L.	PS01	
Lageos - A Geodynamics Tool in the Making. Submitted to the Journal of Geological Education.		
STEINOLFSON, R. S.	UAH	
TANDBERG-HANSEN, E.	ES51	
Thermally Conductive Flows in Coronal Holes. Submitted to Solar Physics.		
STONE, N.	ES53	
SAMIR, U.	ES53	
WRIGHT, K.	ES53	
Considerations of Plasma Disturbances Created by Probes in the Ionosphere		

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(Available only from authors. Dates are clearance dates.)

and Their Impact on Low Energy Measurements Performed on Spacelab. Submitted to the Journal of Geophysical Research.

STONE, NOBIE H. ES23
An Instrument for Measuring the Differential Ion Flux Vector. Published in the Review of Scientific Instruments.

TANDBERG-HANSEN, E. ES51
SHEELEY, N. ES51
SMITH, J. B. ES51
Analysis of Solar-Flare Plasmas Using EUV and X-Ray Data. June 12-15, 1977. Presentation at the 150th Meeting of the American Astronomical Society to be held at Atlanta, Georgia.

TANNER, E. RAY EL32
BURGER, J. J. ESA
Contribution of the Spacelab Data Management System to Lower Cost Space Research. October 10-16, 1976. Presentation at the International Astronautical Federation, 1976 Congress, to be held at Anaheim, California.

TEUBER, D. L. ES52
WILSON, R. M. ES52
HENZE, W., JR. ES52
Time-Varying Oscillations in the Solar Soft X-Ray Flux as Observed from Skylab. Submitted to Astronomy and Astrophysics.

TEUBER, D. ES51
REICHMAN, E. J. ES52
WILSON, R. M. ES52
Oscillations in the Solar Soft X-Ray Flux as Observed from Skylab. June 12-15, 1977. Presentation at the 150th Meeting of the American Astronomical Society to be held at Atlanta, Georgia.

THOMPSON, JAMES R., JR. SA51
Space Shuttle Main Engine. April 27-29, 1977. Presentation at the 14th Space Congress to be held at Cocoa Beach, Florida.

TRAHAN, J. F. ES74
LACY, L. L. ES74
Determination of Liquid-Phase Immiscibility in the Lead-Zinc System. Submitted to the Journal of Material Science and Technology.

URBAN, EUGENE W. ES63
Design and Operation of a Superfluid Liquid Helium System for an Infrared Astronomy Experiment on Spacelab. January 16-18, 1977. Presentation at the AIAA 16th Aerospace Sciences Meeting to be held at Huntsville, Alabama.

VAUGHAN, WILLIAM W. ES81
Experiments on Atmospheric Processes. May 12, 1977. Presentation at the Symposium on Engineering and Productivity Gains from Space Technology to be held at MSFC, Alabama.

WAITES, HENRY B. ED12
Application of Model Reference Adaptive Control to Instrument Pointing Systems. January 16-18, 1978. Presentation at the 16th AIAA Aerospace Sciences Meeting to be held at Huntsville, Alabama.

WATKINS, JIMMY R. ES52
A Digital Image Processing System. October 18-19, 1977. Presentation at the NASA/UAH Data Management Symposium to be held at MSFC, Alabama.

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WEAVER, EDWIN A.	EC35	WOJTALIK, FRED S.	EE71
Laser Doppler Technology Applied to Atmospheric Environmental Operating Problems. October 19-20, 1976. Presentation at the Aircraft Safety and Operating Problems Conference to be held at Langley Research Center, Hampton, Virginia.		High Energy Astronomy Observatory Program (HEAO). June 12-16, 1977. Presentation at the Seventh IFAC World Congress to be held at Helsinki, Finland.	
WEST, E. A.	ES52	YOUNG, L. E.	EC12
HAGYARD, M. J.	ES52	ELMS, R. V., JR.	LMSC
CUMINGS, N. P.	ES52	SEP Full-Scale Wing Technology Development. Aug. 28-Sep. 2, 1977. Presentation at the 12th I. E. C. E. C. to be held at Washington, D. C.	
The Interpretation of Polarized Intensity Measurements in Terms of Transverse Fields in Sunspots. June 12-15, 1977. Presentation at the 150th Meeting of the American Astronomical Society to be held at Atlanta, Georgia.			
WILSON, R. M.	ES52		
REICHMANN, E. J.	ES52		
SMITH, J. B., JR.	ES52		
SPEICH, D. M.	ES52		
Long Lived Soft X-Ray Transients Observed During Skylab. June 12-15, 1977. Presentation at the 150th Meeting of the AAS to be held at Atlanta, Georgia.			
WINDER, S.	ED01		
GLAESE, J.	ED01		
VALLELY, P.	ED01		
JEWELL, R.	ED01		
SSME HPFTP Stability and Response Analysis. September 26-28, 1977. Presentation at the 1977 Vibrations Conference to be held at Chicago, Illinois.			
WINKLER, CARL E.	ES61		
KORSCH, DIETRICH	ES61		
Primary Aberrations for Grazing Incidence. Published in Applied Optics.			

NASA REFERENCE PUBLICATION

RP-1005

August 1977

Fronts and Frontogenesis as Revealed by High Time Resolution Data. Albert E. Frank and David A. Barber. Space Sciences Laboratory.

Upper air soundings taken every 3 hours are used to examine a cold front of average intensity over a period of 24 hours. Vertical cross sections of potential temperature and wind and horizontal analyses are compared and adjusted until they are consistent with one another. These analyses are then used to study the evolution of the front, which is found to consist of a complex system of fronts occurring at all levels of the troposphere. Low-level fronts are strongest at the surface and rapidly weaken with height. Fronts in the middle and upper troposphere are much more intense. The warm air ahead of the fronts is nearly barotropic, while the cold air behind the fronts is baroclinic through deep layers. A deep mixed layer is observed to grow in this cold air.

Examination of cross sections of potential temperature and potential vorticity indicates that the air in at least the upper portions of the upper level fronts originates in the stratosphere. No evidence is found, however, of an extrusion of stratospheric air to very low levels. The structure of the upper level fronts is complex. These fronts are observed to split apart, recombine, and descend to low elevations due to the incorporation of pre-existing stable/baroclinic layers.

An equation for parcel-following frontogenesis in isentropic coordinates is developed and applied. No single process was found to be dominant in changing frontal intensity. Frontogenesis occurs on the

leading edge of the fronts and frontolysis on the trailing edge. The magnitudes of the computed frontogenesis decrease downstream from the axis of the upper level trough.

Isentropic trajectories are constructed to verify the computed values of parcel-following frontogenesis. Poor correlations found between the computed and trajectory-following values of frontogenesis are believed to be due to nonlinearities in the field of frontogenesis and to errors in the trajectories.

Vertical velocities are computed using a kinematic technique. Reasonable fields of vertical velocity are obtained in the vicinity of the fronts and jet streaks. Good correlations are found between the vertical displacement between endpoints of the trajectories and the value of computed vertical velocity integrated over the path of the trajectory. The field of vertical velocity is also found to be highly nonlinear.

APPROVAL

FY1977 SCIENTIFIC AND TECHNICAL REPORTS, ARTICLES, PAPERS, AND PRESENTATIONS

Compiled by O. L. White

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

A handwritten signature in dark ink, appearing to read "J. T. Shepherd", is written over a horizontal line.

J. T. SHEPHERD

Director, Administration and Program Support